

## **Characteristics of Sediment at Chetco Boat Basin and Entrance on the Chetco River, 1996**

### **Abstract**

1. Sediments from the Federal channel located in the Chetco River estuary were sampled 24 June 1996 and subjected to physical and chemical analysis under an ongoing sediment quality characterization effort conducted by the Corps of Engineers. Sediment quality investigations of adjacent Non-Federal commercial and sport boat basins were conducted concurrently by the Environmental Protection Agency (EPA) with the Corps performing sample collection, testing and reporting of results in support of EPA. Sediment from the Federal channel is gray-colored sand and gravel, with silty sand in some zones. Sediment in the boat basins is dark gray and black silt with sand. Total organic carbon (TOC) is generally higher in the boat basins than in the Federal channel, but test results show low and moderate TOC values in each area. Cadmium was slightly over the screening level in one sample. All other values for metals were below screening levels. Pesticides DDE and DDT were found at below the minimum detection level at one location in the commercial boat basin. The values for PAH's were below established concern levels, with one exception which exceeded the maximum level of concern for total PAH's.

### **Introduction**

2. This report documents the results of the 24 June 1996 sediment quality investigation of the Chetco River Federal channel and two adjacent Non-Federal boat basins. Sediment characterization of Chetco River Federal channel was initially undertaken in 1982 by the Corps in response to a need for determining the suitability of dredged materials for in-water disposal. More comprehensive sampling and testing of Chetco Federal channel sediments were undertaken in 1991. EPA funded the Corps to further characterize the sediment quality parameters of the Non-Federal boat basins.

### **Background**

3. The Chetco River Flows into the Pacific Ocean at Brookings, Oregon which is about 300 miles south of the Columbia River. The Chetco River is 59 miles long and drains a 359-square-mile basin. Nearly all of the basin is within the Siskiyou National Forest. The Chetco's main tributary, the North Fork of the Chetco drains 40 square miles and is 14 miles long. At approximately 140 acres, the Chetco River estuary is one of the smallest on the Oregon coast. Rainfall in the basin varies from 80 inches annually at the mouth to about 120 inches annually in the Siskiyou mountains in the headwaters of the Chetco River. Average annual water yield at the mouth is 1,230,000 acre-feet.

4. The Chetco estuary is dominated by fluvial action and most of the sediment yield produced by the Chetco River is transported through the estuary to the ocean. The Corps of Engineers is responsible for maintaining a 14 foot depth in the Federal channel which dominates the estuary ( Figure 1). Dredged materials are placed in the designated offshore Ocean Dredged

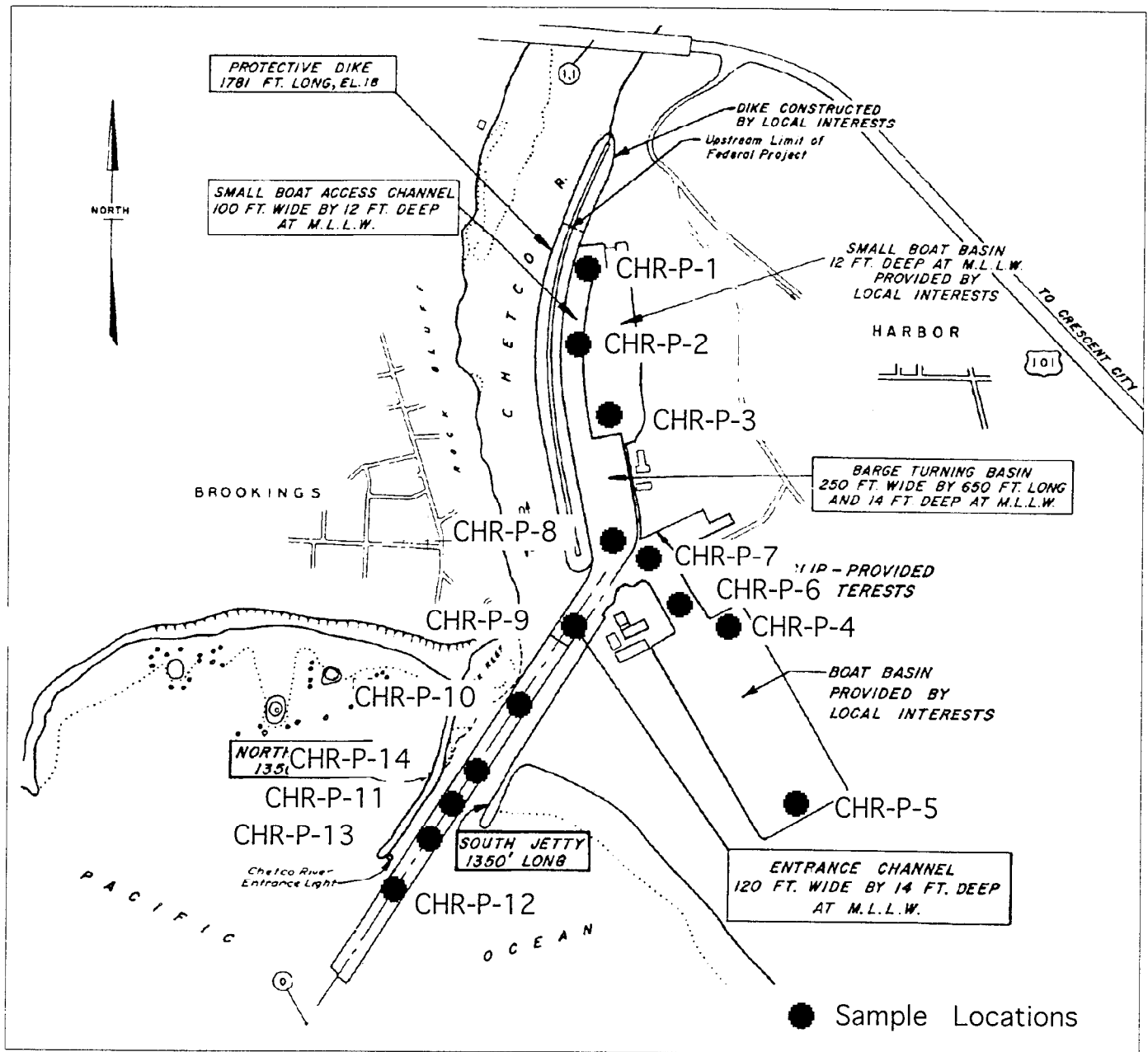


Figure 1: Chetco River, Sample Location Map June 1996.

Material Disposal Site (ODMDS) or in a nearshore berm area. Average annual dredging volume between 1976 and 1985 amounted to 47,792 cubic yards.

5. Sediments in the Chetco River Federal channel are predominately fine sands with a volatile solids content, a rough measure of the organic fraction of the sediment, ranging from 1.29 to 7.19 percent. After considerable volumes of these materials were transported to the estuary by flood waters in 1996, the values rose somewhat to between 1.9 and 10.9 percent. Some chemical analyses of sediments from the estuary were performed in 1982 and 1991. There were no unusual elevations of metals, pesticides or PCB's. However, nickel, chromium, copper and other metals and minerals characteristic of very deep crustal source rocks that are prevalent in the Siskiyou mountains were found in these sediments at levels near or above screening levels. Sediments from Southern Oregon coastal streams and dredged from the Federal channel are similar to the ODMDS sediments as described in the Corps' 1988 dredged material disposal site evaluation and EPA's 1991 EIS.

6. The purposes of the present study is to provide additional data on physical and chemical character of the sediment in the Federal channel and to determine whether or not those sediments are contaminated with chemicals of concern. Since there is a greater potential for contaminants to be generated and remain for extended periods in closed boat basins than in the Federal channel, sediments from the two Non-Federal boat basins were investigated in both this and in the 1991 Corps - EPA joint study. The samples requested by EPA for this investigation focused on sediment quality of the boat basins. Data obtained from those sediments along with the sediment data collected from the Federal project serve to characterize sediment quality from the Chetco estuary which has potential to be placed in the ocean dredged material disposal site. Sampling outside the Federal channel was conducted in the commercial boat basin and in the sport fishing boat basin (See Figure 1).

## **Methods**

7. Fourteen samples were collected using a Ponar grab sampler which takes a sample about 9 cm thick, representative of the surface sediments. These samples were subjected to physical tests including density, void ratio, volatile solids, specific gravity, particle size classification (ASTM D2487) and particle roundness. Chemical testing follows EPA protocols.

8. Nine samples were selected for chemical analysis. These were collected from the Ponar sampler using acid washed stainless implements and were placed in "clean" jars and packed in ice during transport to the Corps' Portland District North Pacific Division Laboratory (NPD Lab) at Troutdale, Oregon. Sediment samples were cold-stored and shipped to Columbia Analytical Services (CAS), NPD's contract laboratory. Sediments were analyzed for the following chemicals of interest:

total organic carbon (TOC);  
metals including , arsenic, cadmium, chromium, copper, mercury, lead, silver, zinc;  
organotins, mono- to tributyltin (TBT);

polycyclic aromatic hydrocarbons (PAH);  
polychlorobiphenyls (PCB);  
Pesticides.

Chemical tests were run according to standard or modified EPA methods.

## **Results/Discussion**

9. The raw data from the physical and chemical analysis are on file at the Portland District, Corps of Engineers. Sampling locations are shown on Figure 1. Note that the boat basins are designated "Sport Basin" for the smaller upstream marina and "Commercial Basin" for the larger downstream marina. The samples EPA requested be included in this investigation are designated CHR-P-1 through -5, while CHR-P-6 through -14 are those samples from the Corps' Federal project.

10. Results of physical analysis are shown in Table 1. The sediments in the Chetco River proper tended to be coarse-grained, consisting of sands and gravels, with the sand fraction having around 40 to 50 percent medium-grained sands retained on the 1 to 2mm sieve. Simple inspection shows these sediments are coarser than those from the boat basins or the channel leading to the basins. Sediments in the boat basins and the entrance leading to the Federal channel were sandy silt. In the sands and gravels organics ranged between 1.9 and 5.8 percent, except for CHR-P-11 at 10.9 percent. This high value is apparently because of a significant amount of partially decomposed leaves, twigs and wood fragments in the sample. Grabs at locations CHR-P-10, -11, -13, and -14 all had a significant volume of small (1 to 2 cm diam.) twigs and branches within the sample. Depth readings across short reaches of the outer channel at these locations indicates a waveform bottom configuration, the troughs of which are apparently trapping and holding water-logged masses of fragmented upland vegetation that show little or no signs of decomposition as well as completely decomposed organics and shell fragments in mixtures with silt. These deposits are crudely stratified with organic silts interlayered with sandy gravels and overlain by about 50mm of fine sands that appear to have been washed from backwater areas of the river into the wave troughs during an episode of high energy flow. A waveform bottom configuration has not been reported in previous studies, but was noted at other coastal entrances during the 1996 sediment quality studies. However, the Chetco was the only place where the troughs appeared to have trapped materials that were strikingly different from the surrounding bottom sediments.

11. There is a marked contrast in the texture and appearance between sediment in the Non-Federal boat basins and that in the adjacent river bed. The sediment in the basins is a dark gray and black plastic silt. Organic content of the sandy silts taken from the boat basins and the access channel ranged between 3.8 and 9.6 percent. The silts emit a strong odor characteristic of anaerobic digestion processes commonly found in closed basins with little or no circulation. Sample CHR-P-4 classified as silty sand, had brown colored streaks within black groundmass, and was difficult to obtain because the Ponar unit was blocked with twigs, 1.5 cm tree limbs and, or medium-sized gravel on two successive retrieval attempts. Since these sediments are physically similar to the materials on the adjacent bankline and decidedly different from dark gray

and black organic silts within the basin, these bank materials are believed to be the source of gravel and brownish colored sandy soil which was taken from CHR-P-4. This location was not sampled nor do previous reports address the peculiar composition of sediment, gravel, and undecomposed upland vegetation that was found in the boat basin during the 1996 investigation.

### **Chemical Analysis**

12. Table 2 shows the results of total organic carbon analysis. Values of TOC for the boat basins and access channel ranged from 1.08 in CHR-P-3, which reflects low organic content for the silt in the access channel at the downstream end of the sport basin, to 4.14 in CHR-P-5 from the downstream end of the commercial basin. Note that looking at the positions from which these samples were taken, TOC values increase with increasing distance from the access channel. This appears to represent a gradient in the organic content of the sediments in each basin which may be caused by prevailing water circulation patterns that concentrate organics in the closed ends of the basins. As with volatile solids, the highest TOC value found, 6.42 %, was in CHR-P-11 taken from a trough in the bottom sediment in the outer reach of the Federal channel where it would not be expected to occur.

13. Selected metals of interest and arsenic occurred in all sediments analyzed (Table 2). Cadmium was slightly over the screening level at one location in the sport basin (CHR-P-1), however, all other values are below screening levels and no further testing is necessary.

14. Pesticide and PCB results are shown in Table 3. The only chemicals detected in this category were 4,4'-DDD, (0.8ppb) and 4,4'-DDT, (1ppb) in CHR-P-4 sampled at the upstream end of the commercial basin. The sediment from this location showed anomalous color variations with the brown-colored fraction believed to have resulted from soil on the adjacent bank being washed into the marina. Site CHR-P-4 was shifted somewhat from the sampling location visited in 1991. Each analyte level is below the laboratory reporting limits of 2ppb for the compound, but above the method detection level of 0.2ppb. In 1991 4,4'-DDD was detected in the barge turning basin at its upstream end, however, DDT was not found at any of the sampling locations. In addition to DDD, the DDT derivative, 4,4'-DDE, and endosulfan sulfate were also detected in the sample from the barge turning basin in 1991. In 1982, DDE was detected, also in sediment from the barge turning basin. The reason for the variation in pesticide compounds and their concentrations among sampling episodes in the barge turning basin is unknown, but since they are below established levels of concern, no further action is necessary.

15. There were no PCB's found in any of the samples tested in 1996, however, the 1991 investigation disclosed a PCB level of 277 ppb in the upstream portion of the sport basin near the dock. That same site, (CHR-P-2) was sampled during this study, but PCB was not found.

16. All sediment samples analyzed contained PAH's with fluoranthene and pyrene showing the highest concentration levels in each of the samples (See Table 4). Only CHR-P-4 and -5 from each end of the commercial basin, CHR-P-4 near its entrance, CHR-P-5 at the closed end, contained PAH's, in concentrations higher than screening levels (See Table 4). In fact CHR-P-4

had combined levels of fluoranthene, 1,800 ppb and pyrene at 1,200 ppb at a level of 3,000 ppb which far exceeds the upper level of concern, 2,410 ppb Total PAH. Samples CHR-P- 4, -5, and -6 had iridescent, silver oil sheens in the water issuing from the silt after it was allowed to stand in the sample catcher for less than a minute. Four samples, CHR-P-6, -7, -8, and -11, analyzed for PAH were collected from the Federal channel. Total PAH content of sample CHR-P-8 was 732, which is far below both screening and established concern levels for total PAH.

17. Organotins were detected in all samples tested. Table 3 shows analytical results for TBT all of which were below the established level of concern, 73 ppb (TBT). Sample CHR-P-5 (56 ppb) was taken from the closed end of the commercial boat basin. Sample area CHR-P-4 was located specifically to evaluate the potential for TBT contamination of the sediments at dock A. DEQ had expressed strong concerns that the reported sandblasting of the FV Sara in 1994 had contaminated the area including the Federal channel with TBT. As reflected in the grainsize analysis, CHR-P-4 does have a large component of sand size particles which is inconsistent with "natural" deposition in this area. This would strongly suggest that sandblasting did take place in this area. However, the TBT level at the dock does not reflect the removal of TBT laced paint as the TBT level (13 ppb) is similar to the general trend for the entire boat basin. All TBT concentrations are well below levels known to be the direct result of sandblasting of TBT bottom paints.

18. Of all the sites tested, CHR-P-5 had higher levels of more of the anthropogenic pollutants. The same site tested high for PAH, TBT, DDT or its derivatives and total metals when investigated in 1982 and 1991. Given the fact that the site is in a backwater located at the closed end of a boat basin, forming an effective trap, it is understandable that pollutants tend to collect and remain in this location. It is difficult to suggest a means whereby any of the pollutants of interest could escape from this reach, which is borne out by the lack of similarly polluted sediments being found in the Federal channel.

## **Quality Control**

19. Matrix spike and surrogate recoveries were within +/- 40 percent, which is within acceptable quality control limits for all organic compounds submitted for analysis. Analyses were performed in conformance with the quality assurance program of Columbia Analytical Services, Inc. (CAS). The analyses were consistent with the Corps' Tier II data requirements. Method blank or surrogate recoveries, as applicable to each analytical method are reported in the raw data received from CAS and on file in the Portland District. All EPA recommended holding times were met for analyses of these samples. One sample, CHR-P-5 yielded a high recovery for the naphthalene-d8 surrogate because of matrix interference, however, no corrective action was taken since all other quality control associated with the analyses was acceptable.

## **Conclusions**

20. The sediments in the boat basins are classified as fine-grained, that is, more than 50 percent of the sediment is silt and, or clay. Fine-grained sediments, including organic silts and

especially clay, are of great importance to sediment quality issues because particles of organic compounds and clay carry an electrostatic charge capable of forming electrochemical bonds with a wide range of compounds.

21. Comparing the results of analyses between 1991 and 1996, there is no apparent trend in concentrations of contaminants. Most perplexing is the comparison between 1991 and 1996, of pesticide analytes DDT, DDD, DDE and endosulfan sulfate. Beta-BHC was found in the CHR-P-5 location in 1991, but at that time no DDT or its derivatives was found there. This suggests that the organochlorines have undergone decay in the intervening years at locations CHR-P-2, -3, and -8, while DDD and DDT was either introduced or migrated, into the commercial basin where CHR-P-4 was taken. The fact that values reported in this study are somewhat lower than those reported in 1991, and were found at only one site instead of four sites, indicates a possible reduction in the pesticide contamination present in the Chetco estuary sediments. However, with these two compounds slightly above the method detection limits, but below method reporting level, the difference may be a product of the inherent variability in the analytical method. The presence of these compounds at these levels is not considered a concern at this time.

22. There was PCB at a concentration of 277 ppb in the sediment at CHR-P-2 in the sport basin in 1991, however, this investigation did not detect PCB's at any of the sample locations.

23. PAH's were found at all sites, including CHR-P-6, -7, -8, and -11 from the Federal channel. There was an oily sheen visible in the sediment during on-site processing of samples from CHR-P-3, -4, -5, and -6. Sample CHR-P-4 and CHR-P-5 had PAH concentrations above concern level ( 5,000 ppb vs the 2,410 ppb concern level), but this is not deemed a problem relative to dredging the Federal channel because sediment from site CHR-P-4 and -5 are confined within the commercial basin. Fueling operations, painting or other possible sources of the high PAH concentration level were not observed during the sediment sampling activities. However, considering the fact that commercial and sport fishing activity is likely to remain at about 1996 levels, it is reasonable to assume that PAH concentrations will remain unchanged.

24. Organotins, including TBT were also present in all sediments analyzed. The TBT levels in CHR-P-5 were closest to the 73ppb screening level (56ppb), which is about 10ppb higher than the site yielded in 1991. Also in 1991, a significant TBT level was found at CHR-P-1 near the boat ramp in the sport basin. The level at CHR-P-1 has fallen from 69ppb in the 1991 analysis to 17 ppb reported in this investigation. Although there has been significant reduction in TBT levels, continued periodic monitoring of fine grained materials from the Federal channel reach at the basin entrance is a prudent management strategy. The heightened organotin content of sample CHR-P-8 taken in the Federal channel near the entrance to the boat basins was low with TBT being present at a concentration of 13ppb. In any case, all TBT levels detected are below established concern levels and no further actions are needed.

## **Recommendation**

25. The Chetco estuary has sediment with most contamination below established levels of concern and with contaminants being confined to the commercial boat basin and sport boat basin areas. The discovery of the dark gray, fine-grained sediment at the mouth of the jetties has not been previously reported, and a source for the materials recovered in CHR-P-11 cannot be discerned using the data presented here. The material sampled from the Federal channel was well below levels of concern. Indeed there were only two samples, both from the commercial boat basin that had analysis results that were above levels of concern. This is in general agreement with the findings in 1991 and 1982 and is to be expected, since there is continuing commercial activity in the area. Considering these analysis results, along with potential contaminant sources, it would be prudent management strategy to continue periodic monitoring of sediment quality in the Chetco estuary. Since the sediment in the Federal channel is sand and gravel which does not tend to combine with or retain chemicals of interest, there is no need to undertake further chemical analysis or Tier III biological testing of these sediments. Materials dredged from this source are deemed suitable for open-water disposal.



Table 1.

sample	mean gr. size mm	sand %	silt	clay	volatile solids
CHR-P-1	0.013	5.9	82.4	11.7	6.8
CHR-P-2	0.015	4.8	82.8	12.4	6.2
CHR-P-3	0.055	43.8	50.1	6.1	3.6
CHR-P-4	0.130	67.7	26.7	5.6	4.0
CHR-P-5	0.016	20.8	68.1	11.1	9.6
CHR-P-6	0.067	52.5	40.5	7.0	3.8
CHR-P-7	0.025	14.7	72.1	13.2	5.1
CHR-P-8	0.074	56.8	34.8	8.4	3.8
CHR-P-9A	29.500	99.3	0.6	0.1	2.6
CHR-P-9B	34.500	98.0	1.6	0.4	2.3
CHR-P-10	2.350	96.8	2.1	1.1	2.6
CHR-P-11	7.450	81.2	16.6	2.2	10.9
CHR-P-12	0.310	96.5	1.4	2.1	1.9
CHR-P-13	0.140	87.1	10.4	2.5	3.1
CHR-P-14	1.600	81.9	16.4	1.7	4.8
CHR-P-14B	0.11	68.0	28.5	3.5	5.8

Table 2. Concentrations of metals, AVS, and TOC in the Chetco River sediments samples, 1996

sample	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	TOC	AVS
ppm											
um/g											
CHR-P-1	10.0	1.05	63.4	47.8	14.6	0.13	85.3	0.18	95.2	2.26	
CHR-P-2	8.0	0.87	59.4	43.3	13.7	0.11	79.4	0.16	87.6	2.15	
CHR-P-3	6.0	0.49	49.8	49.2	8.9	0.08	72.7	0.06	77.8	1.08	
CHR-P-4	5.0	0.44	60.2	35.9	14.0	0.08	74.8	0.07	88.7	1.32	
CHR-P-5	8.0	0.34	45.5	70.0	18.1	0.13	54.1	0.1	96.4	4.14	
CHR-P-6	7.0	0.20	43.5	34.2	10.1	0.09	70.2	0.06	68.2	2.12	250
CHR-P-7	11.0	0.22	54.7	48.8	16.0	0.1	72.4	0.1	77.4	1.69	620
CHR-P-8	8.0	0.17	62.0	34.5	10.1	0.1	72.4	0.1	66.9	1.33	440
CHR-P-11	9.0	0.25	46.0	25.8	7.6	0.08	70.1	0.08	57.9	6.42	600
mean	8.0	0.45	53.8	43.3	12.6	0.10	72.4	0.10	79.6	2.5	477.5
1991 mean	8.1	0.65	68.0	55.0	10.1	0.20	89.0	ND	112.0		
screening levels	57	0.96	180	81	66	0.21	140	1.2	160		

Table 3. Concentrations of pesticides and PCBs in the Chetco River sediment samples, 1996

sample	Alpha-BHC	4,4'DDT	4,4' DDD	endosulfan II	PCBs	TBT
	ppb					
CHR-P-1	ND	ND	ND	ND	ND	17
CHR-P-2	ND	ND	ND	ND	ND	10
CHR-P-3	ND	ND	ND	ND	ND	12
CHR-P-4	ND	1.0	0.8	ND	ND	13
CHR-P-5	ND	ND	ND	ND	ND	56
CHR-P-6	ND	ND	ND	ND	ND	2
CHR-P-7	ND	ND	ND	ND	ND	0.3
CHR-P-8	ND	ND	ND	ND	ND	13
CHR-P-11	ND	ND	ND	ND	ND	10
mean						15.2

Screening Levels:

Pesticides DDT 15-20

PCB's 400-500

Table 4. Concentrations of PAHs and phenols in the Chetco River sediment samples, 1996

sample	naphthalene	2-methyl naphthalene	acenaphthylene	acenaphthene	dibenzofuran	fluorene	phenanthrene	anthracene	fluoranthene	pyrene	benz (a) anthracene	chrysene	benzo (b) fluoranthene	benzo (k) fluoranthene	benzo (a) pyrene	indeno (1,2,3-c,d) pyrene	dibenz (a,h) anthracene	benzo (g,h,i) perylene	total
ppb																			
CHR-P-1	16	14	3	10	25	26	73	48	162	197	38	84	35	50	25	19	4	18	847
CHR-P-2	15	13	4	8	21	24	77	50	269	235	46	130	49	65	30	24	5	21	1086
CHR-P-3	26	8	2	6	14	16	50	26	147	148	41	84	32	45	23	14	4	12	698
CHR-P-4	36	44	19	139	76	103	610	141	1800	1200	284	520	225	242	138	84	18	67	5746
CHR-P-5	15	17	9	18	21	30	180	72	480	450	620	170	100	110	69	57	13	53	2484
CHR-P-6	11	10	ND	11	10	16	50	10	86	71	18	26	12	16	10	6	2	6	371
CHR-P-7	1	ND	ND	ND	ND	2	6	ND	14	13	6	6	6	6	6	4	ND	4	74
CHR-P-8	6	6	3	5	7	10	52	24	192	182	41	74	29	42	26	16	4	13	732
CHR-P-11	ND	ND	ND	ND	ND	0.9	10	13	ND	8	3	5	ND	ND	2	2	ND	2	46
mean	16	16	7	28	25	28	137	53	394	312	137	137	61	72	41	28	7	24	1505

Screening Levels: Total PAH's 1500-2000